(12) UK Patent Application (19) GB (11) 2 155 270 A

(43) Application published 18 Sep 1985

(21) Application No 8500445

(22) Date of filing 8 Jan 1985

(30) Priority data

(31) 59/001258 (32) 10 Jan 1984 (33) JP

(71) Applicant
Dainippon Screen Mfg. Co. Ltd. (Japan),
1-1 Tenjinkitamichi, Teranouchiagaru 4-chome,
Horikawa-dori, Kamikyo-ku, Kyoto, Japan

(72) Inventors
Masakatsu Yokoi,
Tsutomu Harada

(74) Agent and/or Address for Service
Urquhart-Dykes & Lord,
Beckett's Bank Chambers, 19 Cheapside,
Bradford BD1 4HR

(51) INT CL[4]
G01S 17/32 G05D 3/10

(52) Domestic classification
H4D 711 730 747 748 752 757 775 783 78X
G3R A273 BC27
H4F CA S1 S27E S42M S42P S49S1 S89S1
U1S 2102 2110 2115 G3R H4D H4F

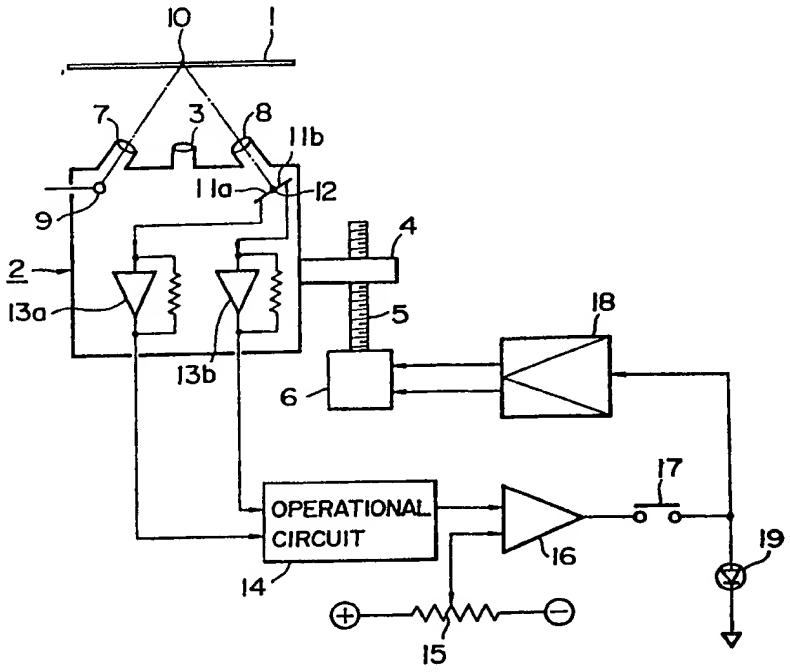
(56) Documents cited
GB A 2137841 GB 1471383
GB A 2101303

(58) Field of search
H4D
G1A
H4F
G3R

(54) **Focusing a scanning system**

(57) In order to focus a scanning optical head 3 on a surface 1, in this case the surface of a picture of uncertain thickness mounted on the drum of a colour scanner or a film surface in an analogous recording system, a light beam from source 9 is directed onto the surface 1 and received by a photosensor comprising two photosensitive portions 11a, 11b. When the head 3 is at the correct distance from surface 1, the output from the two portions 11a, 11b is equal; any inequality is used to move head 3 to the correct position.

FIG. 1



GB 2 155 270 A

FIG. 1

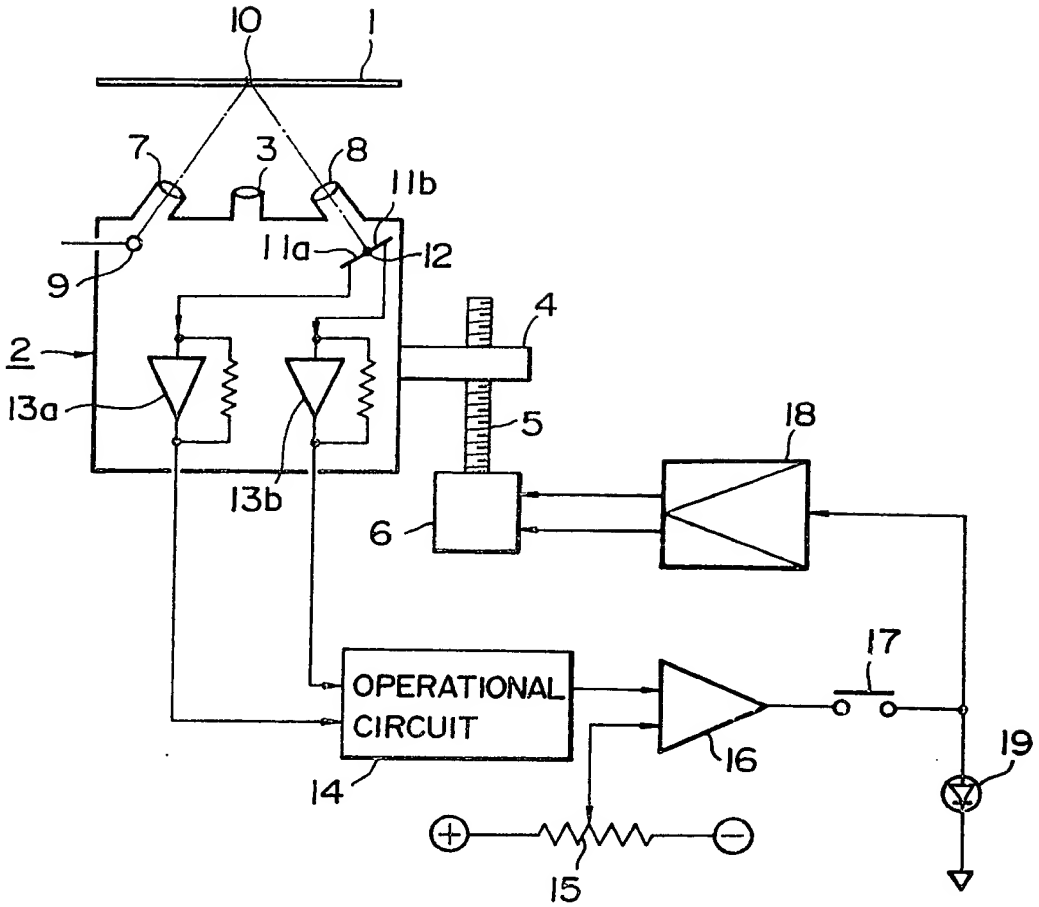

10
1
7
3
8
11b
11a
12
9
2
4
13a
5
18
13b
6
OPERATIONAL
CIRCUIT
17
16
19
14
15

FIG. 2

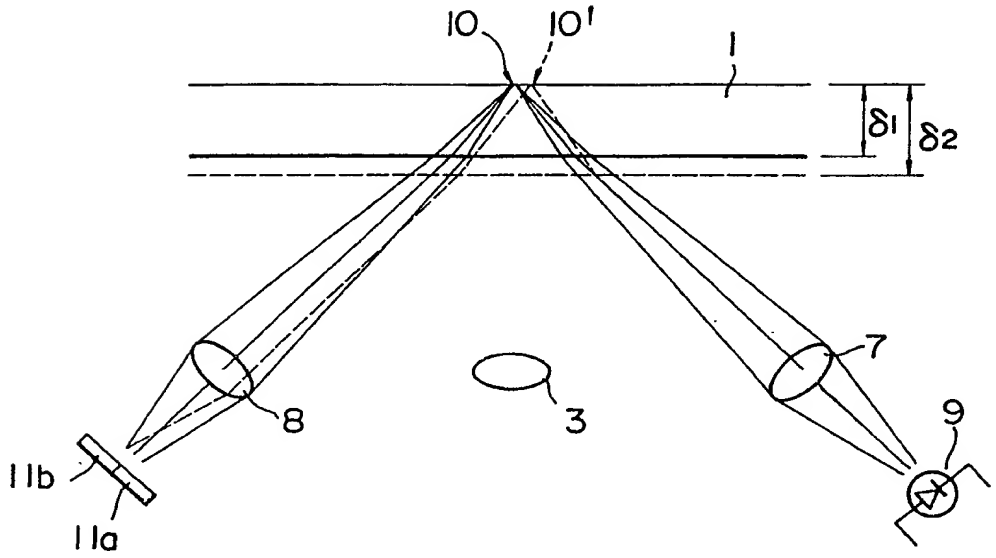
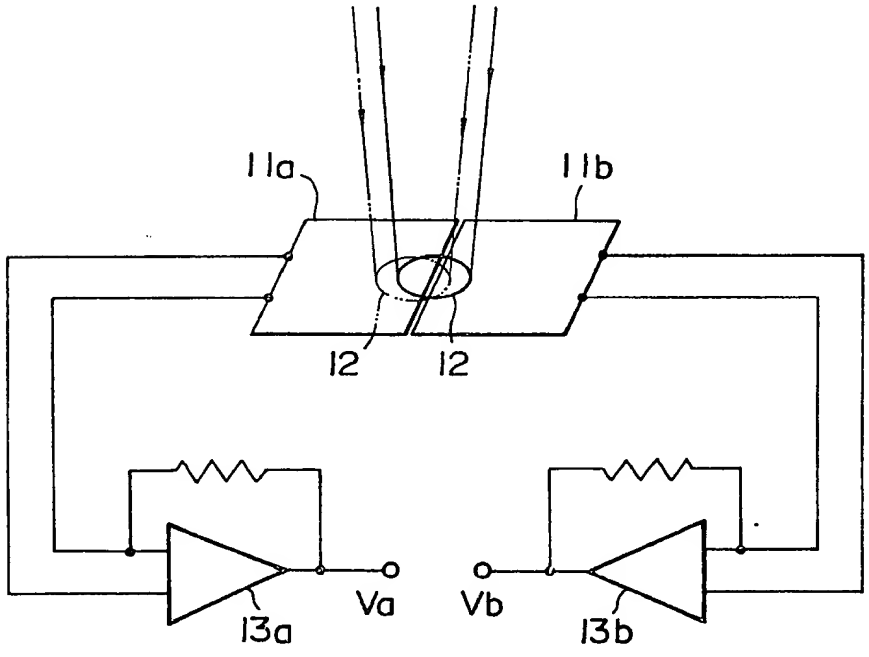


FIG. 3



SPECIFICATION

A picture scanning and recording method

The present invention relates to a picture scanning and recording method for maintaining a scanning head or a recording head on a focus matching position on the film surface applied onto an original picture drum or that of a photoelectrical material applied to a recording drum by controlling position of the scanning head or the recording head in a picture scanning and recording apparatus such as color scanner etc.

In the present method there are two cases and they are identical with each other essentially. One of the cases is to apply the present method to the scanning side of the picture scanning and recording apparatus and the other is to apply it to the recording side. However, the former case is more complicate than the latter case, so that hereinafter we will explain the former case, i.e., more complicate case.

For example, in a color scanner of rotary drum type, positional relation between the original picture applied onto the scanning drum and a pick-up lens of the scanning head must be focus-matched relation.

However, practically quality of material of the original picture film and thickness thereof are somewhat differenet from each other by those makers thereof, accordingly, prior to carry out scanning, manually controlling an adjusting screw by an operator is required so that the pick-up lens may be moved minute distance in the front or rear direction to the original picture drum to scan the original picture being in focus and signals are picked up.

However, such adjustment is time-consuming work for the persons not in proficient in the art and even for the operator it is hard to precisely adjust it, and quality of final printings is liable to be deteriorated.

In addition, shape of the original picture on which the original picture is applied, particularly, because of manufacturing precision of size of the outside diameter, the drum is not strictly constant with respect to its axial direction, so that, even if the operator focuses the lens, during the original picture being photoelectrically scanned, slipping off focusing point is liable to occur.

Therefore, it is an object of the present invention to provide a picture scanning and recording method for correcting position of a scanning head of a picture scanning and recording apparatus with respect to a scanned light point on an original picture drum by easily detecting slipping off of a pick-up lens from its focusing point. Hereinafter, the present invention will be described in detail with respect to a preferred embodiment referring to the accompanying drawings.

Figure 1 is a view showing a circuit for practising method of the present invention;

Figure 2 is a plan sketch showing showing an optical part for illustrating operational principle of the present invention; and

Figure 3 is an enlarged perspective view of a light receiving part of the circuit shown in Figure 1.

In Figure 1, the reference number 1 designates an original picture applied onto an original picture drum (not shown) used generally in the picture scanning and recording apparatus, the reference number 2 designates a scanning head and 3 indicates a pick-up lens.

The scanning head 2 is adapted to be driven in the direction parallel to an axial direction of a drum (right and left directions in Figure 1) by a known feeding means (not shown) which feeds the scanning head 2 in the sub-scanning direction (right and left direction in Figure 1), and to a supporting arm 4 projecting from one side of the scanning head 2, a threaded rod 5 disposed in the direction perpendicular to the axial direction of the original picture drum is screwed. The threaded rod 5 is rotated by a servo-motor 6.

Accordingly, the scanning head 2 is constructed, same as those of the conventional ones, so as to be able to move in the sub-scanning direction and also able to move minute distance in the direction intersecting at right angles with the axial line of the original picture drum so that the method according to the present invention may be practised.

As shown in Figures 1 and 2, in each of right and left sides of a pick-up lens 3 mounted on the scanning head 2, there are provided a light projecting means and a light receiving means respectively, each of which optical axes intersect with each other on the original picture 1.

In the rear of a light projecting lens 7 in the light projecting means, for exmple, there is provided a light point source 9 comprising such as a laser diode or luminescent diode etc. which is adapted to focus a micro light point 10 on the film surface of the original picture 1.

In the rear of a light receiving lens 8 in the light receiving means, for example, there is provided a light sensor 11 comprising two divided regions 11a and 11b oppositely disposed so as to produce a somewhat dimmed image 12.

The above fact is, for the reason that, as will be described hereinafter, patterns on the original picture 1 does not effect output signals output from those divided region 11a and 11b. However, in the case of being applied at the recording side, no such consideration is necessary.

Further, with each of the divided regions 11a and 11b current-voltage converting amplifiers 13a and 13b mounted in the inside of the scanning head 2 are connected, respectively.

These amplifiers are adapted so that when the pick-up lens 3 of the scanning head 2 is scanning the original picture 1 in focused state, i.e., when thickness of a base film is δ_1, as shown in a solid line in Figure 2 and the light point 10 is in the reference position (in Figure 2 it is on the optical axis), an image 12 of the light point 12 is focussed on an equilibrium position as shown by a solid line in Figure 3, that is, mounting equally on each of the divided regions 11a and 11b of the light sensor 11.

Accordingly, at this time outputs Va and Vb of both current-voltage converting amplifiers 13a and 13b become equal to each other independent on reflecting light quantity P of the ligth point 10.

However, in a case in which thickness of the base film of the original picture 1 is not changed, but the material thereof is changed, or on the contrary in other case in which the material is not changed but changes in thickness etc., for example, if thickness of the base film changes, as shown by a dotted line in Figure 2, from δ_1 to δ_2, the light point 10 on the film surface of the original picture 1 displaces slightly to a position 10 shown in Figure 2, so that the image 12 of the light point 10 on the light sensor displaces slightly, as shown by two-dotted line in Figure 3, for example, so as to expose the divided region 11b of the light sensor 11 more intensely.

Assuming that the whole amount of received light at this time on the divided regions 11a and 11b of the light sensor 11 is P, 100 x % of the whole amount of received light is received on the region 11a and the remained 100 (1 − x)% thereof is received on the region 11b, difference between those two outputs Va and Vb is represented by the following formula; that is, $Va - Vb = Px - P(1 - x) = P(2x - 1)$. Thus, value of the above formula is proportion to the whole amount of received light P.

The whole amount of received light P differs according to each of picture pattern areas of the original picture so that if the difference between the both output Va and Vb is directly utilized for focusing the lens, exact focusing control can not be achieved influenced by magnitude of the whole amount of received light P.

$$\frac{Va - Vb}{Va + Vb} = \frac{\rho(2x - 1)}{\rho} = 2x - 1$$

Therefore, in the present invention, as shown in the following formula, by utilizing ratio to the sum of the both outputs Va and Vb to the difference therebetween, the pick-up lens 3 can be exactly focussed independently on the whole amount of received light.

In addition, value of x, that is, position of an optical axis of a reflecting light beam from the original picture on the light sensor 11 varies in proportion to change of thickness of the base film of the original picture, and the focus-matched position (the position on which the lens focuses) of the pick-up lens 3 varies in proportion to value of

$$\frac{Va - Vb}{Va + Vb}.$$

Accordingly, by comparing value of

$$m \cdot \frac{Va - Vb}{Va + Vb}$$

(m is constant) with that of reference voltage, and relatively moving minute distance the scanning head 2 to the original picture so as to make the difference zero, the pick-up lens 3 is positioned on the focusing position to the film surface of the original picture 1.

An operational circuit 14 in Figure 1 is connected with the current-voltage converting amplifiers 13a and 13b, and from outputs Va and Vb thereof the above described value

$$M \cdot \frac{Va - Vb}{Va + Vb}$$

is calculated. The output is input to a differential amplifier 16 together with output voltage of a reference voltage setting means 15, and differential voltage thereof is amplified.

Further, an output of the differential amplifier 16 is input to a servo amplifier 18 through a pushing button switch 17, and by the outut thereof the servo-motor 6 is rotatively controlled so that the output of the operational circuit 14 may cause the scanning head 2 to displace so as to approximate to the output of the reference voltage setting means 15. Thus distance between the original picture 1 and the pick-up lens 3 of the scanning head 2 is controlled so as to become a predetermined value.

The reference number 19 shown in Figure 1 is a detection indicating lamp comprising of a luminescent diode etc., and when the focussing position of the pick-up lens 3 of the scanning head 2 is determined, that is, when output of the differential amplifier 16 becomes zero, the detection indicating lamp 19 and the light point source 9 are turned off to let the operator known that he may switch off the push button switch 17.

Operation for positioning the pick-up lens 3 of the scanning head 2 to the focussing point continues during the original picture 1 being scanned, if the operator does not switch off the push button. For example, even if the outside diameter of the original picture drum varies in the axial direction thereof, the focusing point of

the pick-up lens 3 to the film surface of the original picture 1 can be maintained.

As described the above, according to the present invention, the amount of reflected light of the light point 10 can determine the distance between the original picture 1 and the pick-up lens 3 automatically, having nothing to do with light and shade of the original picture 1, by simple operation of the push button switch 17.

In the above description regarding slightly dimmed image 12 of the light point 10 only brief description is given, however, hereinafter we will give further detailed description. Because of there being light and shade patterns on the original picture 1, if the image 12 of the light point 10 is too sharp, images thereof are focused on both light sensers 11a and 11b by which there may be apprehension that outputs of them are not proportion to light receiving areas thereof. With the same reason it is desired that the light point 10 is relatively minute.

In the above description, for detecting position of the image 12 on a light sensor of the light point 10, those two divided light sensors 11a and 11b are used, of course, quartered light sensors also can be utilized, and in addition, semiconductor light position detectors such as CCD etc. may be used.

The method according to the present invention can be applied, as described the above, easily to the recording side. Even if applied as such case, it is quite identical in essential with the above mentioned case, so that further detailed explanations are not added.

While the described embodiment represents the preferred form of the present invention, it is to be understood that modifications will occur to those skilled in that art without departing from the spirit of the invention. The scope of the invention is therefore to be determined solely by by the appended claims.

CLAIMS

1. A picture scanning and recording method whereby picture signals are obtained by photoelectrically scanning an original picture applied on to an original picture drum having a scanning head which moves in the axial direction of said original picture drum, characterised by:

minutely displacing said scanning head in a direction perpendicular to a scanning light point on said original drum according to variation of a substantial distance between the surface of an original picture film and a pick-up lens of said scanning head; and

maintaining said scanning head in a focused position on the surface of said original film.

2. A picture scanning and recording method whereby a reproduced picture is recorded by sequentially scanning a photosensitive material applied on to a recording drum by a recording head which moves in the axial direction of said recording drum, characterized by:

minutely displacing said recording head in a direction perpendicular to a recording light point on said recording drum according to a substantial variation in distance between the film surface of said photosensitive material and a focusing lens of said recording head; and

Maintaining said recording head in a focused position on the film surface of said photosensitive material.

3. A picture scanning and recording method substantially as hereinbefore described with reference to and as illustrated by the accompanying drawings.

Printed in the UK for HMSO, D8818935, 7/85, 7102.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.